

### Remarks

Claims 1-61, 63-66, and 68-171 remain pending in the application. Claims 62 and 67 were cancelled herein. Claims 1, 27, 66, 101, 108, 109, and 128 have been amended as shown above. The claims were amended to more fully clarify the invention. No new matter has been added by the amendments above. Favorable reconsideration is respectfully requested in light of the above amendments and the following comments.

The Examiner objected to the drawings because Figure 37 is asserted to be two drawings. Applicants include herewith a proposed drawing correction that rennumbers the two figures "Figure 37a" and "Figure 37b".

The Examiner objected to claim 101 because it did not have a period, and claims 109 and 128 because of incorrect units. Claims 101, 109, and 128 have been amended in accordance with the Examiner's suggestions.

The Examiner rejected claims 1-11, 14-21, 33, 36, 38-40, 42-46, 48, 50, 51, and 53-63 under 35 U.S.C. § 102(e) as being anticipated by Allan (U.S. Patent No. 6,243,522). Applicants respectfully traverse this rejection.

The Examiner rejected claims 66-69, 74, 77, 80, 83, 87-89, 97, 98, 101, 102, 105, 108, 110, 115-119, 122-125, 130-138, 145-147, 151, 152, 154, 155, 157, 159-163, 167, 168, and 170 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) in view of DiGiovanni (U.S. Patent No. 5,907,652). Applicants respectfully traverse this rejection.

The Examiner rejected claims 70-73 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of IEEE article "Holey Optical Fibers: An Efficient Modal Model" (Monro et al.). Applicants respectfully traverse this rejection.

The Examiner rejected claims 22-25, 29, 32, 35, 37, 41, 49, 52, 64, and 65 under 35 U.S.C. § 103(a) as being unpatentable over Allan in view of Vali (U.S. Patent No. 5,155,792). Applicants respectfully traverse this rejection.

The Examiner rejected claims 30, 31, and 34 under 35 U.S.C. § 103(a) as being unpatentable over Allan in view of Monro et al. Applicants respectfully traverse this rejection.

The Examiner rejected claims 75, 76, 78, 79, 81, 82, 84, 85, 86, 90-96, 99, 100, 103, 104, 106, 107, 113, 114, 120, 121, 126-129, 140-144, 148-150, 153, 156, 158, 165, 166, and 171 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of Allan. Applicants respectfully traverse this rejection.

The Examiner rejected claims 139, 164, and 169 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of WO 00/49436 (Russel et al.). Applicants respectfully traverse this rejection.

The Examiner rejected claims 12, 13, and 47 under 35 U.S.C. § 103(a) as being unpatentable over Allan and Vali in view of WO 99/00685 (Birks). Applicants respectfully traverse this rejection.

The Examiner rejected claim 109 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of WO 99/00685 (Birks). Applicants respectfully traverse this rejection.

The Examiner rejected claims 111 and 112 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) and Allan in view of Vali. Applicants respectfully traverse this rejection.

### **35 U.S.C. § 102 Rejection**

The Examiner rejected claims 1-11, 14-21, 33, 36, 38-40, 42-46, 48, 50, 51, and 53-63 under 35 U.S.C. § 102(e) as being anticipated by Allan (U.S. Patent No. 6,243,522).

Allan discloses a photonic crystal fibre (PCF) that is "free of air filled pores in the clad layer" (see col. 2, line 35). Allan is focused on a non-porous clad fibre. In the background of the invention, Allan describes that previously known PCFs include a porous clad layer. Allan defines a porous clad layer as "a clad layer containing an array of voids". Allan further describes the disadvantages of using porous clad PCFs; e.g. difficult manufacturing (see col. 1, line 35-39) and OH- contamination causing increased

losses (col. 1, lines 47-50). As can be seen by this discussion, a main topic of Allan's invention is a non-porous clad PCF (see col. 6, line 23).

Allan also discloses a preform for making a non-porous clad PCF. The preform is made by using clad rods (col. 3, line 2-4) and one or more core rods (col. 3, line 22-23). It is a further requirement that the clad has a lower effective refractive index than the core (col. 3, line 57-59). Allan states that the preform may comprise interstitial voids and these voids may optionally be filled in at the preform level (see col. 4, line 63-66). Hence, it is clear that the voids referred to in claim 17 (of Allan) are the interstitial voids of the preform and that they are not present in the final fiber (the fiber being a non-porous clad PCF as stated above). The preform voids are for example eliminated by "filling in some or all of the interstitial voids..." by "Glass rods or glass-forming material in granular or powder form" as described in col. 4, line 64-67 and claim 18.

The present claim 1 relates to a microstructured optical fiber that includes core features and cladding features that can be rods or voids, in particular, "one or more of the cladding features are voids". Consequently, this claim differs from the disclosure of Allan who neither discloses nor suggests, and in fact teaches away from porous clad PCFs, the cladding of which comprising voids. Because Allan does not disclose all of the limitations of the currently pending claims, Applicants respectfully request that this rejection be withdrawn.

### **35 U.S.C. § 103 Rejections**

The Examiner rejected claims 66-69, 74, 77, 80, 83, 87-89, 97, 98, 101, 102, 105, 108, 110, 115-119, 122-125, 130-138, 145-147, 151, 152, 154, 155, 157, 159-163, 167, 168, and 170 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) in view of DiGiovanni (U.S. Patent No. 5,907,652).

DiGiovanni '236 discloses microstructured fibres (these fibres also being known as PCFs) with special dispersion properties and nonlinear fibres. For the fibre shown in Fig. 5 of DiGiovanni '236, the inner cladding voids have a larger diameter than the voids of the outer cladding region. Thus, the effective refractive index of the outer cladding region is larger than the effective refractive index of the inner cladding region. This is very much in contrast to the fibre according to independent claims 66, 69 or 131, in

which an inner cladding region and an outer cladding region both have cladding features, but where the cladding regions and the cladding features are designed so that “the inner cladding region having an effective refractive index  $N_i$  and the outer cladding region having an effective refractive index  $N_o$  with  $N_i$  being larger than  $N_o$  at the operating wavelength”.

Although Applicants' invention addresses similar applications for the fibers disclosed by DiGiovanni '236, Applicants' fibers are very different from the fibers disclosed by DiGiovanni '236. In particular the claimed fibers have the property that  $N_i$  is larger than  $N_o$  which is contrary to that of DiGiovanni '236 who teaches away from such a refractive index relation between the inner cladding and the outer cladding. In all examples and claims, DiGiovanni '236 teaches that  $N_i$  is smaller than  $N_o$ . Hence, DiGiovanni '236 neither indicates nor suggests PCFs with special dispersion properties and having  $N_i$  larger than  $N_o$  according to the fibres of the independent claims 66, 69, and 131.

DiGiovanni '652 discloses optical fibers with increased NA and/or insensitivity to external influences, e.g. a fibre of novel structure, selected to yield high NA and/or to be essentially re-coat insensitive (col. 2, line 66 – Col. 3, line 6). The increased NA and/or re-coat insensitivity is obtained by using a first outer cladding with a lower effective refractive index than an inner cladding. DiGiovanni '652 discloses fibers with a solid inner cladding for applications such as cladding pumped fiber amplifiers and laser, and fibers with long period gratings. DiGiovanni '652 does not address optical fibres with special dispersion properties or an ability to manipulate dispersion.

In order to establish *prima facie* obviousness, three basic criteria must be met, namely: (1) there must be some suggestion or motivation to combine the references or modify the reference teaching; (2) there must be a reasonable expectation of success; and (3) the reference or references when combined must teach or suggest each claim limitation. Applicants submit that the Office Action failed to state a *prima facie* case of obviousness, and therefore the burden has not properly shifted to Applicants to present evidence of nonobviousness.

Applicants respectfully assert that one of skill in the art would not have been motivated to apply the teaching of DiGiovanni '652 to solve the problem that Applicants'

solved, i.e., to provide PCFs with special dispersion properties (such as dispersion compensating fibers and non-linear optical fibres). Applicants utilized an inner cladding region comprising inner cladding features, an outer cladding region, and the relationship of  $N_i$  being larger than  $N_o$  to obtain such special dispersion properties as mentioned above. Nothing in DiGiovanni '236 or DiGiovanni '652 would suggest Applicants' invention to one of skill in the art.

Applicants also respectfully assert that the combination of the references fails to teach all of the limitations of the instant invention. There is a fundamental difference between the fibers disclosed by DiGiovanni '652 and the fibers disclosed by Applicants' invention. The fibers of Applicants' invention uses  $N_i$  larger than  $N_o$  to affect the light guided in the core (namely to provide special dispersion properties). The fibers of DiGiovanni '652 uses  $N_i$  larger than  $N_o$  to obtain a high NA of light guided in the cladding and/or to obtain a fiber with optical properties that are essentially independent of a second outer cladding (a fiber that is insensitive to outside influences). Hence, the fibres disclosed by DiGiovanni '652 use a conventional index difference between the core and the inner cladding. Nothing new is taught or suggested by DiGiovanni '652 or DiGiovanni '236 about how to affect the properties of light guided in the core (especially not how to affect the dispersion properties). In particular, nothing new is taught about how to affect the dispersion properties of microstructured fibre using inner cladding features, such as defined in amended claim 66 claim 69 and claim 131 of the present invention. Because the combination of DiGiovanni '236 and DiGiovanni '652 fail to teach or suggest all of the limitations of Applicants' invention, Applicants respectfully assert that the Examiner has failed to make out a *prima facie* case of obviousness.

Applicants also take exception with the Examiner's arguments beginning on page 10, first full paragraph, last two sentences. Applicants respectfully assert that the Examiner has mischaracterized DiGiovanni '652. DiGiovanni '652 teaches that it would be advantageous to use a "second" outer cladding (col. 4, lines 55-58) of typical silica which does not essentially affect the optical properties of the fibre but which is generally provided to strengthen the fibre. Also, the coating does not affect the optical properties either. It is the core, the inner cladding, and the first outer cladding which affect the

optical properties of the fibre in Applicants' invention. None of these fibre elements are being disclosed by DiGiovanni '652 as affecting the dispersion properties of the fibre.

Because the Examiner failed to make out a *prima facie* case of obviousness, Applicants respectfully request that this rejection be withdrawn.

The Examiner rejected claims 70-73 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of IEEE article "Holey Optical Fibers: An Efficient Modal Model" (Monro et al.). Applicants reiterate the above comments with respect to DiGiovanni '236 and DiGiovanni '652 and assert that Monro et al. fails to remedy the shortcomings of DiGiovanni '236 and DiGiovanni '652. Applicants therefore respectfully request that this rejection be withdrawn.

The Examiner rejected claims 22-25, 29, 32, 35, 37, 41, 49, 52, 64, and 65 under 35 U.S.C. § 103(a) as being unpatentable over Allan in view of Vali (U.S. Patent No. 5,155,792). Applicants reiterate the above comments with respect to Allan and assert that Vali fails to remedy the shortcomings of Allan. Applicants therefore respectfully request that this rejection be withdrawn.

The Examiner rejected claims 30, 31, and 34 under 35 U.S.C. § 103(a) as being unpatentable over Allan in view of Monro et al. Applicants reiterate the above comments with respect to Allan and assert that Monro et al fails to remedy the shortcomings of Allan. Applicants therefore respectfully request that this rejection be withdrawn

The Examiner rejected claims 75, 76, 78, 79, 81, 82, 84, 85, 86, 90-96, 99, 100, 103, 104, 106, 107, 113, 114, 120, 121, 126-129, 140-144, 148-150, 153, 156, 158, 165, 166, and 171 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of Allan. Applicants reiterate the above comments with respect to DiGiovanni '236 and DiGiovanni '652 and assert that Allan fails to remedy the shortcomings of DiGiovanni '236 and DiGiovanni '652. Applicants therefore respectfully request that this rejection be withdrawn.

The Examiner rejected claims 139, 164, and 169 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of WO 00/49436 (Russel et al.). Applicants reiterate the

above comments with respect to DiGiovanni '236 and DiGiovanni '652 and assert that Russel et al fails to remedy the shortcomings of DiGiovanni '236 and DiGiovanni '652. Applicants therefore respectfully request that this rejection be withdrawn.

The Examiner rejected claims 12, 13, and 47 under 35 U.S.C. § 103(a) as being unpatentable over Allan and Vali in view of WO 99/00685 (Birks). Applicants reiterate the above comments with respect to Allan and assert that Vali and Birks fail to remedy the shortcomings of Allan. Applicants therefore respectfully request that this rejection be withdrawn.

The Examiner rejected claim 109 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) in view of WO 99/00685 (Birks). Applicants reiterate the above comments with respect to DiGiovanni '236 and DiGiovanni '652 and assert that Birks fails to remedy the shortcomings of DiGiovanni '236 and DiGiovanni '652. Applicants therefore respectfully request that this rejection be withdrawn.


The Examiner rejected claims 111 and 112 under 35 U.S.C. § 103(a) as being unpatentable over DiGiovanni (U.S. Patent No. 5,802,236) and DiGiovanni (U.S. Patent No. 5,907,652) and Allan in view of Vali. Applicants reiterate the above comments with respect to DiGiovanni '236 and DiGiovanni '652 and assert that Allan and Vali fail to remedy the shortcomings of DiGiovanni '236 and DiGiovanni '652. Applicants therefore respectfully request that this rejection be withdrawn.

Conclusion

In view of the amendments and comments presented herein, favorable reconsideration in the form of a Notice of Allowance is respectfully requested.

Respectfully submitted,  
MERCHANT & GOULD P.C.  
P.O. Box 2903  
Minneapolis, MN 55402-0903  
612.332.5300

Date: 2/24/03

  
John A. Gresens  
Reg. No. 33,112  
JJG:AMN





## Marked up version of Claims

### In the Claims

Please cancel claim 62, 67, without prejudice or disclaimer thereof. Please amend claims 1, 27, 66, 101, 108, 109, and 128 as follows.

1. (Once Amended) A micro-structured optical fibre for transmitting at least a predetermined wavelength of light, said optical fibre having an axial direction and a cross section perpendicular to said axial direction, said optical fibre comprising:

a core region having a multiplicity of spaced apart core features that are elongated in the fibre axial direction and disposed in a core material, said core region having an effective index of refraction  $N_{co}$ ; and

a cladding region surrounding said core region, said cladding region comprising a multiplicity of spaced apart cladding features that are elongated in the fibre axial direction and disposed in a first cladding material, and said cladding region having an effective index of refraction  $N_{cl}$ , wherein a plurality of said cladding features have a cross-sectional dimension perpendicular to said axial direction being larger than said predetermined wavelength, and wherein one or more of said cladding features are voids.

27. (Once Amended) A micro-structured optical fibre according to claim 26, wherein a part of or all of the core features have a cross-sectional dimension being larger than  $0.2 \text{ } [\square] \mu\text{m}$ .

66. (Once Amended) An article comprising a micro-structured optical fibre for guiding light at an operating wavelength, said optical fibre having an axial direction and a cross section perpendicular to said axial direction, the optical fibre comprising: a core region having an effective refractive index  $N_{co}$  and being surrounded by a cladding region comprising a multiplicity of spaced apart cladding features being elongated in the axial direction and disposed in a first cladding material, the cladding features having a refractive index that differs from a refractive index of the first cladding material, the cladding region further comprising an inner cladding region surrounding the

core region and an outer cladding region surrounding the inner cladding region, the inner cladding region having an effective refractive index  $N_i$  and the outer cladding region having an effective refractive index  $N_o$ , with  $N_i$  being larger than  $N_o$  at the operating wavelength, wherein the inner cladding region comprises the first cladding material and the cladding features disposed therein, the first cladding material thereby constituting an inner cladding material and the cladding features disposed in the first cladding material constituting a multiplicity of spaced apart inner cladding features.

101. (Twice amended) An article according to claim 66 or 79, wherein the refractive index of the core material is substantially identical to the refractive index of the inner cladding region material.

108. (Twice Amended) 108. An article according to claim 66, wherein the core has a diameter larger than  $2\text{ }\mu\text{m}$ .

109. (Once Amended) An article according to claim 108, wherein the core diameter is in the interval from 2 to  $10\text{ }\mu\text{m}$ , such as in the interval from 4 to  $6\text{ }\mu\text{m}$ .

128. (Once Amended) An article according to claim 127, wherein said predetermined wavelength is in the range from about  $0.3\text{ }\mu\text{m}$  to  $15\text{ }\mu\text{m}$ [, such as from about  $0.5\text{ }\mu\text{m}$  to  $1.6\text{ }\mu\text{m}$ , such as around  $0.8\text{ }\mu\text{m}$ , such as around  $1.06\text{ }\mu\text{m}$ , such as around  $1.3\text{ }\mu\text{m}$ , such as around  $1.5\text{ }\mu\text{m}$ , such as from about  $1.0\text{ }\mu\text{m}$  to  $2.0\text{ }\mu\text{m}$ , such as from about  $2\text{ }\mu\text{m}$  to  $5\text{ }\mu\text{m}$ , such as from about  $5\text{ }\mu\text{m}$  to  $15\text{ }\mu\text{m}$ ].